# Test and Evaluation of Navigational Recievers

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## Abstract

A new navigational receiver has been introduced for the unmanned aerial vehicles at UMS Skeldar, SPAN CPT7 from NovAtel. It is supposed to replace a less accurate and more clunky PwrPak7D-E1™ but a problem has started to show. During hardware-in-the-loop testing there has been indications of instability during initialisation. This problem needed further investigation, which was the basis of this project. The concern was reasonable since the succeeding testing also showed the receiver being unreliable during start-up and actions had to be made to work around the problem.

## Introduction

The navigational receivers used in this project is using SPAN technology from NovAtel to provide continuous position and attitude. They use GNSS and internal IMU measurements to provide a GNSS+INS solution.

## Method

A non-flight ready helicopter was provided to get accurate antenna positions and representative testing data. The receivers were placed on this platform. The main testing consisted of initialising the receivers and see if they behaved satisfactory. The vehicle must be able to start from a boat due to customary demands. This led to a testing procedure that included static initialisation for basic function and later start-up while moving in different directions to simulate a boat. The start-up during movement was also tested with different intervals of movement, such as continuous movement during full initialisation and movement until receiver sample starts. Data was logged and post-processed with Matlab. Live tests were conducted as well. These consisted of logging sensor data while driving with the helicopter on a trailer around a test route, see Figure 3. While driving the GNSS was turned off momentarily with the purpose of studying the performance of the receivers when just using IMU as well as studying the transitions between off and on.

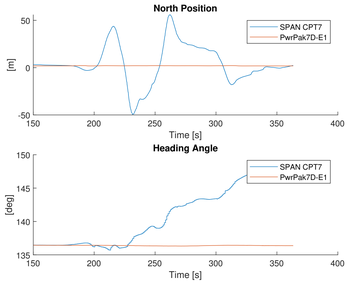


Figure 1: Static start.

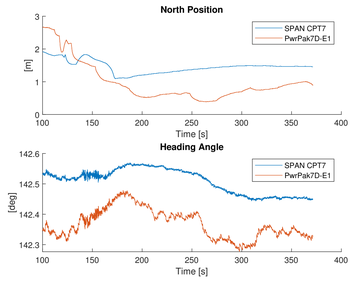


Figure 2: Dynamic start, until IMU sample.

## Results

The concerns which laid the foundation of this project was legitimate. Static start-ups acted unpredictable, showing oscillations and drifting behaviour from the SPAN CPT7. The dynamic start-ups showed that the unpredictable behaviour could be evaded. If the system was moving when the IMU starts to sample the SPAN CPT7 behaved much better. This conclusion was used in live tests by making sure every test started in motion. The results of the live tests showed that the SPAN CPT7 and PwrPak7D-E1™ both recover well when GNSS is back again, see Figure 4

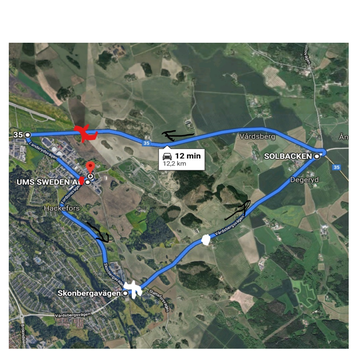


Figure 3: Driving route used in the live tests. "X" marks positions where the GNSS was turned off, "O" where it was turned on.

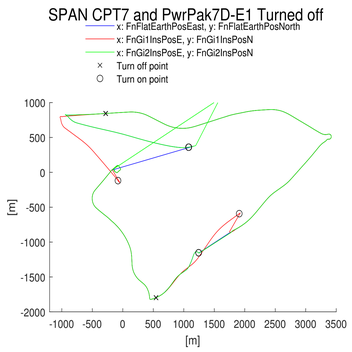


Figure 4: Results of the live tests. The red line represents the SPAN CPT7 solution, the green line indicates the PwrPak7D-E1™ solution and the blue line is the combined solution. "X" marks positions where the GNSS was turned off, "O" where it was turned on.

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